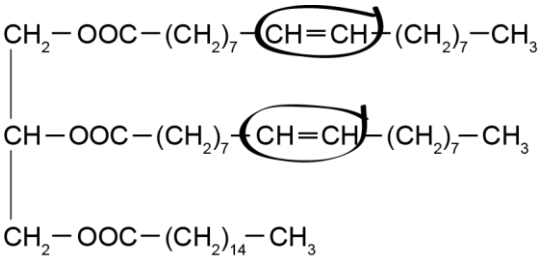
ANSWERS: Esters and Triglycerides

1. (i) Any one of these groups circled:

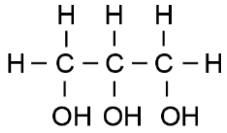


(ii) Bromine water rapidly decolourised from red or orange to colourless in an addition reaction.

OR

Acidified permanganate rapidly decolourised from purple to colourless in a redox or oxidation or reduction reaction.

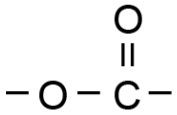
(iii)

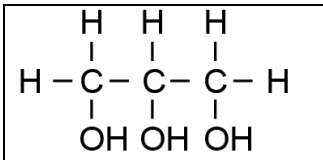
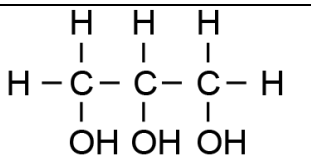


$NaOOC(CH_2)_7CH=CH(CH_2)_7CH_3$

$NaOOC(CH_2)_{14}CH_3$

2. Ester group:

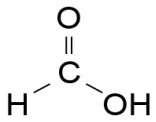


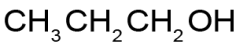
Both acidic and basic hydrolysis produce the same alcohol *propan-1,2,3-triol*.
In addition, they both require heat / reflux
In contrast, acidic hydrolysis requires H_2O / H^+ or HCl(*aq*) and produces the carboxylic acid, whereas basic hydrolysis requires H_2O / OH^- or NaOH(*aq*) and produces the carboxylate ion/salt.

3.

In acidic conditions the products are:

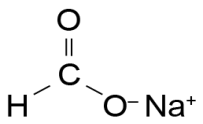


methanoic acid

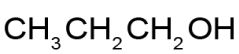


propan-1-ol

In basic conditions the products are:



sodium methanoate / methanoate ion



propan-1-ol

- The ester link is hydrolysed in both acid and basic conditions.
- Both produce an alcohol.

Acidic hydrolysis produces an acid and basic hydrolysis produces a base or salt / following hydrolysis in sodium hydroxide, an acid-base reaction occurs to form the sodium salt and water. (No further reaction occurs in acid.)

4. Both these reactions are hydrolysis reactions where the NaOH (or HCl) reacts with the ester molecule, splitting it apart to form a salt (carboxylic acid) and an alcohol.
With NaOH / basic conditions a salt, CH_3CH_2COONa, and an alcohol, CH_3OH are formed.
$CH_3CH_2COOCH_3 + NaOH \rightarrow CH_3CH_2COONa + CH_3OH$

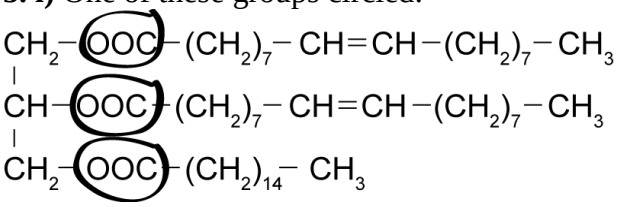
With HCl / acidic conditions the ester forms an alcohol. However, this time a carboxylic acid forms.

$$CH_3CH_2COOCH_3 + H_2O \xrightarrow{H^+} CH_3CH_2COOH + CH_3OH$$

Similarities
- Both reactions are hydrolysis reactions.
- Both reactions form the alcohol CH_3OH.

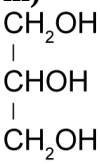
Differences
- One reaction forms the carboxylic acid, the other forms the salt of a carboxylic acid.

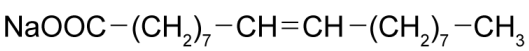
5. i) One of these groups circled:

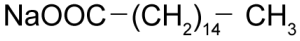


ii) Bromine water rapidly decolourised from orange to colourless.

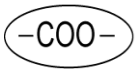
iii)



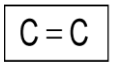




6. i)



ii)



$CH_2=C(CH_3)COOH + CH_3OH$

iii) $CH_3–CCl(CH_3)COOCH_3 + CH_2Cl–CH(CH_3)COOCH_3$

(Allow acid / alcohol products (i.e. ester hydrolysis) /
Allow:
$CH_3–CCl(CH_3)COOH + CH_2Cl–CH(CH_3)COOH$)

7. (Methanoic acid + 2-methylpropan-1-ol → 2-methylpropylmethanoate + water)

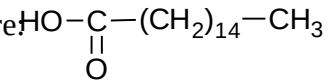
$HCOOH + HOCH_2CH(CH_3)_2 \rightleftharpoons HCOOCH_2CH(CH_3)_2 + H_2O$

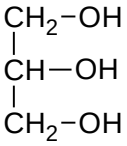
Sulfuric acid is added as a catalyst and/or a dehydrating agent to push the equilibrium reaction towards the product ester by removing the water molecule.
Potassium carbonate is added after completing the reaction to neutralise the excess acid.
Refluxing is used to heat an organic reaction without losing volatile organic reactants or products.
Distillation is used to separate the product from any remaining reactants. It works because all the organic molecules will have different boiling points.

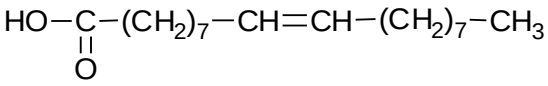
8. i) $CH_2(OH)CH(OH)CH_2(OH)$ – propan-1,2,3-triol

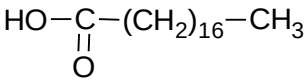
ii) $CH_3(CH_2)_{14}COONa$

9. a) Four products are:





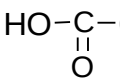
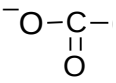
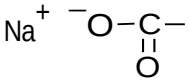




OR

 for acid groups

b) In basic conditions the acid groups, of the 3 acids, would be present as the anion of the acid.

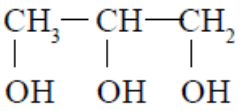
ie   **OR** 

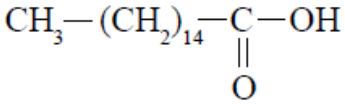
OR **OR**

in acid conditions in basic conditions

10. a)

glycerol 

palmitic acid 

b) In acid conditions the products are glycerol and palmitic acid. In basic conditions the sodium salt of the acid is formed rather than the acid molecule.

11. a) COO group is circled
b) Alcohol/hydroxy/hydroxyl
c) Some carbon–carbon bonds are not single (double or triple).
d) Add bromine solution to the fat drop by drop until the orange colour stays. Count the number of drops added. The more drops taken the more unsaturated the fat.